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THE ORIGIN OF STONY CREEK BASIN, DAYLESFORD, VICTORIA

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Introduction

Stony Creek Basin, Water Supply Reserve No. 1, Parish of Wombat, lies on the south side of Victoria (Jubilee) Park, about $1\frac{1}{4}$ miles south of Daylesford Post Office. It is about 37 acres in area, and 150 feet in depth.

The walls of the basin, and its bedrock floor, consist of Lower Ordovician (Bendigonian) sandstones and shales, capped on the south and east rims by Lower Pliocene quartz gravels, and on the west and north by Newer Basalt. The Tertiary sediments in the basin consist of thin basal quartz drift, a middle bed of 100 feet of ligneous diatomaceous clays, and upper beds 20 feet thick of mottled red and grey sandy clays with quartz boulders.

Previous workers have been: N. Taylor (1894), S. B. Hunter (1896), T. S. Hart (1905), H. S. Whitelaw and W. Baragwanath (1923) and D. Orr (1927 a, b). The present paper deals with:

(i) the evidence of faulting at the basin
(ii) the nature and mode of formation of the basin sediments
(iii) the Llewellyn Lead basalt flow.

The Fault Movements

Most previous workers agree that the steep-walled basin was lowered by faults of the order of 250 feet. Orr (1927a) pictured the accumulation of the sediments in the lake formed when the basin was flooded, but Hart (1905 and recent personal communications) considers that the lignites were deposited on the peneplaned Ordovician prior to the faulting. His chief evidence was the tilted attitude of some of the lignites, and the frequent occurrence of lignites throughout the district.

The author has measured the dips of the lignites where exposed (see Fig. 1) in the 15 feet deep sluiced channels in the south-east portion of the basin. They range from 20° to 50° west to southwest, but bedding planes are indefinite in many exposures; some beds appear horizontal. There is no evidence that the westerly dip is uniform throughout the area, nor of the dip of the deeper beds.

The walls have been closely examined for slickensides, breccia and dyke-rock, but apart from a few small patches of slickenside and brecciated sandstone on the east bank, none was seen. On the east bank a black slate band about 6 inches thick is exposed at different levels descending altogether 150 feet in a distance of 8 chains. Definite step faults, of about 3 feet throw, can be observed in this near the bottom of the basin, and it is possibly step-faulted throughout. It is probably one of the beds of the western leg of the Western Star syncline.

The south bank is regarded (Orr, p. 29) as being defined by a later fault along the eastern extension of the Corinella dyke. No fault breccia was found on the south bank nor in the tunnel along the Jubilee Reef, nor in the several gullies on the south bank. However, on the south-east rim of the basin, near the junction of the Daylesford-Ballan Road with the track to Stony Creek Falls, is a puggy brecciated 'dyke' some $1\frac{1}{2}$ chains wide. It runs E.S.E. from this point to Sweet's claim about 400 yards south of the Ajax South mine (Rising Star Extended). This dyke may well be an extension of the Corinella dyke.

The north bank is almost entirely masked by soil and talus, except for an occasional outcrop of Ordovician sandstone, and a short tongue of basalt from Victoria Park, which lips down to the surface of the basin. In the north-west corner of the basin, west of Stony Creek, where a steep gully runs in, sluicing has exposed a bank some 100 yards long and 30 feet high, in which the material consists of small sub-angular fragments of Ordovician sandstone set in red-brown clay. This material is common in all the hillside debris, but its unusual thickness, and its location at the hiatus in the basalt flow (see Whitelaw's map

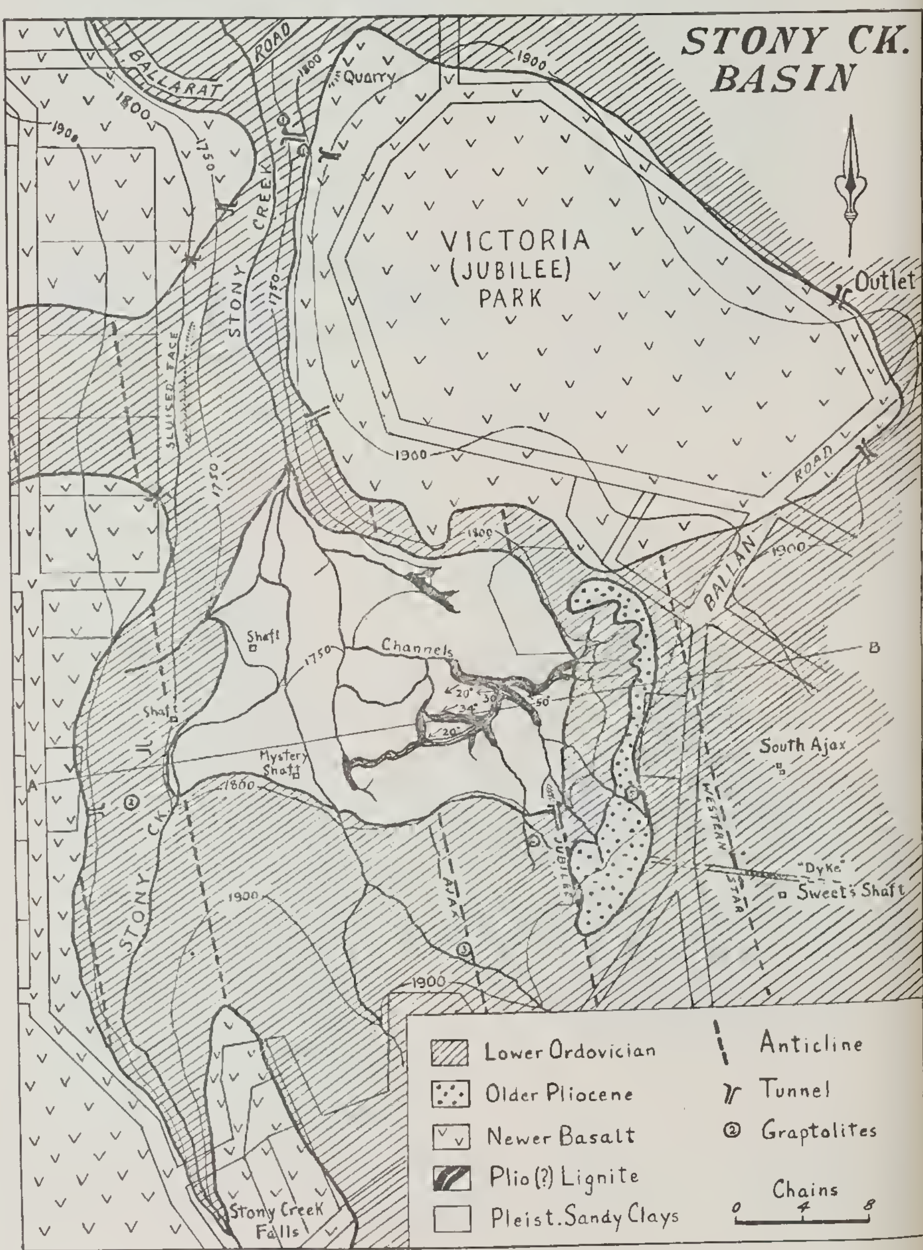

Fig. 1. Stony Creek Basin.

1923) may be significant as indicating broken ground. No Ordovician is exposed in situ here. Seepages are numerous on the western slope of the ridge at this point.

The western wall is almost completely obscured by large basalt boulders from the capping, by piles of stone from the sluicing, and debris from several tunnels under the basalt.

The ' Grand Mystery ' shaft near the south bank is reported (*Daylesford Express*, March 17 and April 9, 1864) to have passed through black ligneous clays, encountering drift at 110 feet and a sloping wall of Ordovician to 117 feet. A small dump at the site of the shaft contains rounded boulders of quartz, quartzite, sandstone and occasional slate, but no lignite. The lignite brought up is reputed (Whitelaw, 1923, p. 12) to have been burnt. The steep slope of the Ordovician suggests that true bedrock was not reached in the shaft. Hunter's map (1896) has a note near the position of the shaft that ' the bedrock goes down almost perpendicular here.'

Thus, within the basin, evidence of faulting is rather scanty. Many traverses were made to prove a surface connection between the basin and the Corinella dyke, but apart from the multiple dykes exposed in the bed of Sailor's Creek, no evidence of continuity was found. There are, however, strong grounds for belief that underfoot there is a connection, as a line of weakness, probably a tension fissure, runs from the hills west of Eganstown to Wheeler's Hill (Musk) in the east. It is occupied at the ends by volcanoes, in its western part by the Corinella dyke of lava, tuff, diatomaceous earth and fault breccia, and near the basin by the ' dyke ' already described as occurring at the south-east rim of the basin. The steep northern bank of Jubilee Lake (originally Wombat Creek) may also be associated with this feature. Bearing in mind the tendency of the dyke to split, as in Sailor's Creek, where the five dykes cover 16 chains, the split dyke in the quarry at Eganstown in Allot. 36 b, Wombat and the width of 14 chains of the Corinella dyke itself, it is possible that two parallel west-east faults some 18 chains apart may have delimited the northern and southern walls of the basin.

Consideration of the general structure of the Daylesford field suggests that the eastern and western walls may also be due to faults. In this brachyanticlinorium, the Dean Dome (Thomas, 1939), the broad Ajax anticline passes through the basin, but the adjacent Western Star and Rising Star anticlines diverge noticeably from it, resulting in a crowding of the folds on the eastern side of the basin. Along any one fold axis in the district, pitch may undulate slightly, but in general the pitch of the folds west of the western Star line, such as the Jubilee and Ajax lines, is northerly, while those to the east, viz., the Rising Star and Cornish lines, pitch southerly at 7° to 10°. There is thus a reversal of direction of pitch in the vicinity of the basin, suggesting weakness in the north-south direction. The actual type of fault is not indicated, but normal gravity faults may be presumed. Thus the basin lies at the intersection of two lines of weakness mutually at right angles (cf. Whitelaw, p. 12).

In the hope of revealing faults, graptolites (see Appendix) were collected from available localities in the vicinity of the basin, but yielded no structural data except that the horizons range from Be4 on the west wall to Be2 on the east, without apparent omission or repetition of beds. No identifiable fossils were obtained from the ' Mystery ' shaft dump.

Tertiary Sediments in the Basin

The only evidence of the existence of the lowest bed of quartz pebble wash, is the newspaper record of the ' Grand Mystery ' shaft quoted by Hart (1905, p. 367). Apparently the bed is only a few feet thick, and consists of waterworn boulders. Its age is a matter of conjecture ; it may correspond with the Older Pliocene gravels and conglomerate (Oldest Drift of Krause 1878, p. 90) at present capping the eastern and southern rims, or it may be correlated with the sub-basaltic gravels of the Llewellyn Lead (Krause's Middle Pliocene or Older Gold Drift). The view is taken here that it is Older Pliocene.

Overlying this are 100 feet of ligneous clays, with occasional thin bands of sand and gravel. The fossil flora has been examined (Patton, 1928; Chapman and Colliver, 1945) but without precise allocation of age. Whitelaw (p. 12) classed both lignite and underlying gravel as Older Pliocene, but mapped the basin area as Newer Pliocene, apparently regarding the upper sandy clays as Newer Pliocene. Taylor (1894, p. 15) classed the lignites as Middle Pliocene and this view is favoured here.

The conditions obtaining during their accumulation are of importance; lignites are formed in shallow water, but the basin deposits are really ligneous and diatomaceous clays, with no stems or trunks embedded. Leaves are the largest fossils. Thus the water may have been deeper than is usual for true lignites, and it is possible that the deposition took place in a deep small lake already formed, rather than in one of which the floor was still subsiding.

The ligneous clays merge into the uppermost formation of unbedded mottled red and grey sandy clays containing large waterworn boulders of quartz, sandstone and conglomerate, but no basalt boulders except a few in the north-east of the basin. Their junction with the lignite is uneven and indistinct, and points to a change in the nature of the material being deposited rather than a time break. The thickness varies from 5 to 30 feet. Much has been removed during sluicing, but the remnants of the original surface show a slope of 1 in 30 to the north-west. It is probable that much of the coarser material has been derived from the walls and rim of the basin.

Concerning the observed dips of some of the upper beds of lignite, factors other than faulting which may account for their tilted attitude are :

(i) they may be foreset beds of a small delta in the lake at the mouth of the stream which entered it ;

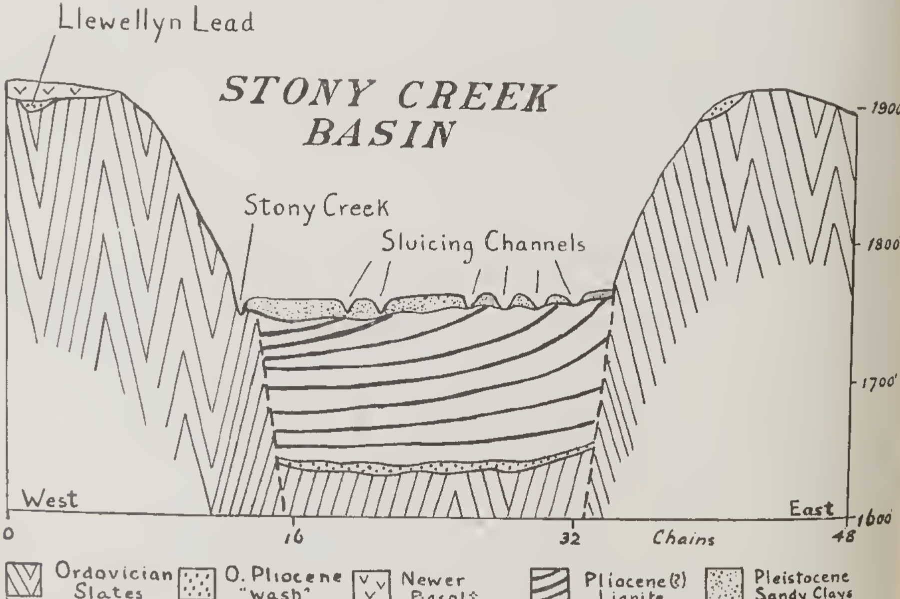

Fig. 2. Section through Stony Creek Basin.

(ii) they may have been horizontal lacustrine deposits of plastic clay which, when wet, became deformed by the pressure of overlying sediments and suffered drag westwards to the deepening valley of Stony Creek.

Llewellyn Lead Basalt Flow

The course of this flow of anorthoclase basalt (Orr, 1927b) is of considerable importance, as it filled the valley of the stream which ante-dated the lateral streams Stony Creek and Sailor's Creek. That the basalt did not cover much of the area of the basin is evident from the absence of residual basalt boulders in the basin, except for a few pebbles in the north-east corner near the basalt tongue, and of course the numerous basalt boulders in the bed and banks of Stony Creek, all of which lie on top of the true sediments.

The question arises: What prevented the basalt flow from filling the basin? The upper surface of the basalt flow is about 1930 feet, while the basin surface is at 1800 feet. Three possibilities occur:

(i) that the basin was not formed until after the Newer Basalt period;
(ii) that the basin was entirely filled with sediments;
(iii) that the course of the lead was such as to skirt the basin.

Regarding (i) there is little possibility that the basin is post-basaltic in age, as correlation with similar deposits in the district, all of which are sub-basaltic (Hart 1905, p. 369) place it in the Middle or Lower Pliocene, while the basalt is at least Upper Pliocene and may be Pleistocene.

Regarding (ii) it is unlikely that sediments entirely filled the basin and their upper 130 feet was removed by denudation, as the basin forms a cul-de-sac on the side of Stony Creek, and would be unfavourably situated for the vigorous erosion postulated.

Turning to (iii), careful measurement of the levels of the numerous small wash tunnels under the five outliers of basalt (Fig. 3) shows that the Llewellyn Lead curved around the north-west corner of the basin, swung around in Victoria Park, and went under Sailor's Hill; beyond there it cannot be traced. The basin was protected from flooding by the then right bank of the lead, composed of Ordovician sediments since removed, but at that time higher than the basalt. A point of entry of water to the basin was at the two-chain tongue of basalt on the north side of the basin, where there was an overflow channel discharging occasionally into the lake. Possibly its deposition was partly deltaic in nature, in which case the tilted attitude of some of the beds could be due to their being foreset beds, or to having slumped.

Due to the development of lateral streams, and rejuvenation by general uplift of the area (Orr, 1927b, p. 35), denudation along the stream valleys has been rapid, removing the basalt barrier in the north-west corner, carving gorges 200 feet deep or more, and leaving the basalt as flat-topped ridges and outliers.

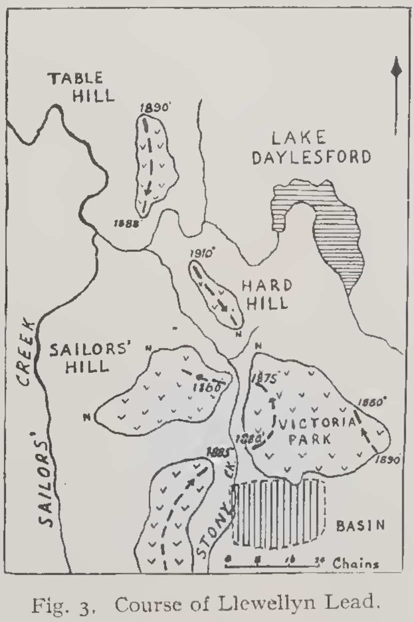

Fig. 3. Course of Llewellyn Lead.
Levels shown are wash drive tunnels. N indicates no wash or tunnels at this point.

Conclusion

The geological history may be summarized thus :

(a) Faulting began in Lower Pliocene times of a rectangular area, along east-west lines due to the Corinella dyke, and north-south lines due to faults associated with crowded folds and reversal of pitch ;

(b) Flooding by Llewellyn Lead streams to form a lake, in which during the Middle Pliocene period there accumulated the ligneous and diatomaceous clays, possibly but not certainly on a subsiding floor ;

(c) Basalt flow from Leonard's Hill, probably Upper Pliocene, occupied Llewellyn Lead, skirted the western rim of basin, but lipped down at one place on north side ;

(d) Development of lateral streams, regional rejuvenation, direct entry of Stony Creek into basin, breaching of basalt barrier, erosion of sediments adjacent to creek, possible sagging of upper lignite beds towards creek valley;

(e) Addition of some hillside detritus from the basin walls to the upper sediments in the basin, extending from Upper Pliocene to Recent times.

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Appendix

List of Graptolites identified by Dr. D. E. Thomas

Locality 1. Near Ballarat Road Bridge over Stony Creek :
Tetragraptus fruticosus 3 br., v. common, *Phyllograptus ilicifolius*, Phyllocarid, *T. pendens*, *Didymograptus* sp., *Sigmagraptus laxus*, *Goniograptus macer*, *G. lureani*, *T. serra*. Be. 4.

Locality 2. Tunnel, west bank Stony Creek, 3 chains south of basin :
Phyllocladus ilicifolius, *T. fruticosus* 3 br. common, *Didymograptus* cf. *similis* *T.* cf. *quadribrachiatus*, *Goniograptus macer*, *Didymograptus* horiz-sp., Phyllocarids. Be.4.

Locality 4. South Bank of basin in gully 30 yards West of Jubilee Reef :
Tetragraptus fruticosus 4 br., *T. pendens*, *T.* cf. *quadribrachiatus* Be. 2 or 3.

Locality 5. East Bank of Basin :
Tetragraptus fruticosus 4 br., *T. pendens*, *T.* cf. *quadribrachiatus*. Be. 2. or 3.

Locality 6 . Gully in South-east corner of basin, 50 feet above floor :
Tetragraptus fruticosus, *T. bryonoides*. Be. 2.